WHAT IS CLAIMED IS:

1. A monitoring apparatus for one or more vapor phase polycyclic aromatic hydrocarbons in a high-temperature environment, comprising:

an excitation source producing electromagnetic radiation;

an optical path having at least a first optical probe, the optical path optically communicating the electromagnetic radiation received at a proximal end of the first optical probe to a distal end thereof such that the electromagnetic radiation interacts with at least one vapor phase polycyclic aromatic hydrocarbon produced by a material undergoing combustion and produces at least one emitted wavelength of radiation characteristic of the at least one vapor phase polycyclic aromatic hydrocarbon; and

a positioner coupled to the first optical path,

wherein the positioner slidably moves the distal end of at least the first optical probe to maintain the distal end position at a desired position with respect to an area of the material undergoing combustion.

2. The monitoring apparatus of claim 1, further comprising:

a wavelength separator in optical communication with the first optical probe to receive the at least one emitted wavelength of radiation; and

a detector operatively connected to the wavelength separator,

wherein the first optical probe receives the at least one emitted wavelength of radiation at the distal end and optically communicates the at least one emitted wavelength of radiation from the distal end of the first optical probe to the proximal end thereof such that the at least one emitted wavelength of radiation is received by the wavelength separator.

3. The monitoring apparatus of claim 2, further comprising a trigger system, the trigger system operatively communicating with the excitation source and the detector.

4. The monitoring apparatus of claim 2, wherein the wavelength separator comprises a spectrometer.

5. The monitoring apparatus of claim 2, wherein the wavelength separator comprises a monochromator or a polychromator.

6. The monitoring apparatus of claim 2, wherein the detector is a CCD camera, a photodiode array, or a photomultiplier tube.

7. The monitoring apparatus of claim 1, wherein the positioner is coupled mechanically, electromagnetically, magnetically, or piezoelectrically to the first optical path.

8. The monitoring apparatus of claim 1, wherein the first optical probe is arranged in a 180° backscatter geometry.

9. The monitoring apparatus of claim 1, further comprising:

a second optical probe,

wherein the second optical probe optically receives the at least one emitted wavelength of radiation emitted from the vapor phase polycyclic aromatic hydrocarbon and directs the at least one emitted wavelength of radiation to a wavelength separator.

10. The monitoring apparatus of claim 9, wherein the first optical probe and second optical probe are arranged in a 180° backscatter geometry, a 90° side scatter geometry or at an angle θ from 0 to 180°.

11. The monitoring apparatus of claim 9, wherein the second optical probe is slidably movable such that a distal end of the second optical probe is maintained at a desired position with respect to an area of the material undergoing combustion.

12. The monitoring apparatus of claim 1, wherein the first optical probe includes a plurality of optical fibers.

13. The monitoring apparatus of claim 1, wherein the first optical probe comprises a plurality of 600-μm SiO_2/SiO_2 fibers, at least one of the fibers being coated at the distal end thereof with a polyimide.

14. The monitoring apparatus of claim 13, wherein the plurality of fibers are arranged in a concentric 6-around-1 configuration.

15. The monitoring apparatus of claim 1, wherein the excitation source comprises a laser.

16. The monitoring apparatus of claim 15, wherein the excitation source further comprises a dye module.

17. The monitoring apparatus of claim 15, wherein the excitation source further comprises an all solid-state tunable source.

18. The monitoring apparatus of claim 17, wherein the all solid-state tunable source is equipped with an optical parametric oscillator.

19. The monitoring apparatus of claim 1, wherein the material undergoing combustion is a burning cigarette, a cigarette-like material, a fuel of a combustion engine, a fuel of a gas turbine engine, or a fuel of a turbine of a power generating plant.

20. The monitoring apparatus of claim 1, wherein the excitation source is a nitrogen laser.

21. The monitoring apparatus of claim 20, further comprising:

a photodiode in optical communication with the excitation source; and

a data collecting device in operative communication with the detector.

22. The monitoring apparatus of claim 21, wherein the data collecting device comprises an oscilloscope.

23. A vapor phase polycyclic aromatic hydrocarbon monitoring apparatus, comprising:

means for generating electromagnetic radiation;

means for directing the electromagnetic radiation to a gaseous by-product produced by a material undergoing combustion; and

means for receiving emitted radiation from the material undergoing combustion having at least one wavelength characteristic of at least one polycyclic aromatic hydrocarbon and directing the emitted radiation to a detecting means,

wherein the means for directing the electromagnetic radiation is positionable to be co-located with the material undergoing combustion such that the electromagnetic radiation causes emitted radiation from the material undergoing combustion and the means for receiving the emitted radiation is positionable to be co-located with the material undergoing combustion such that the emitted radiation is collected.

24. The monitoring apparatus of claim 23, wherein the material undergoing combustion is a cigarette, an organic, or a hydrocarbon.

25. The monitoring apparatus of claim 23, wherein the means for directing the electromagnetic radiation comprises an optical probe positioned within a burning cigarette.

26. The monitoring apparatus of claim 23, further comprising means for analyzing the emitted radiation from the material undergoing combustion.

27. The monitoring apparatus of claim 23, further comprising means for time resolving the monitoring apparatus.

28. A method of monitoring at least one vapor phase polycyclic aromatic hydrocarbon using electromagnetic radiation, comprising:

producing electromagnetic radiation;

directing the electromagnetic radiation along a first optical probe;

positioning a distal end of the first optical probe with respect to an area containing gaseous by-products of a material undergoing combustion;

interacting at least a portion of the produced electromagnetic radiation with the gaseous by-products to produce emitted radiation characteristic of at least one polycyclic aromatic hydrocarbon; and

monitoring the emitted radiation.

29. The method of claim 28, wherein the monitoring comprises directing the emitted radiation to a wavelength separator using the first optical probe.

30. The method of claim 28, wherein the monitoring comprises directing the emitted radiation to a wavelength separator using a second optical probe.

31. The method of claim 28, wherein the electromagnetic radiation is produced from an excitation source.

32. The method of claim 28, wherein the positioning is carried out using mechanical, magnetic, electromagnetic or piezoelectric energy to dynamically position the distal end of the first optical probe.

33. The method of claim 28, wherein at least a portion of the electromagnetic radiation has a wavelength of energy that excites an electron of a vapor phase polycyclic aromatic hydrocarbon to an excited state from which the electron returns to a lower energy state with a concomitant generation of a characteristic emitted wavelength.

34. The method of claim 28, wherein the electromagnetic radiation is a wavelength of energy at approximately 337 nm.

35. The method of claim 28, wherein the material undergoing combustion is a cigarette, a cigarette-like sample, or a fuel.

36. The method of claim 28, wherein the material undergoing combustion is an aerosol sample of mainstream smoke or sidestream smoke from the combustion of a cigarette or a cigarette-like material.

37. The method of claim 28, further comprising detecting a vapor phase polycyclic aromatic hydrocarbon by a characteristic wavelength contained in the emitted radiation.

38. The method of claim 28, wherein the step of positioning locates the distal end of the first optical probe substantially co-located outside an area of the material undergoing combustion, within a combustion zone of a material undergoing combustion, or within an area of the material undergoing combustion outside the combustion zone.

39. The method of claim 38, further comprising gating a fluorescence signal in response to the electromagnetic radiation incident on a photodiode to detect a fluorescence intensity as a function of time, thereby time resolving the detecting step.